Development of a Hydrogen Fuel Based Power Park (New FY 2004 Project)

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Subcontractors:
Collier Technologies - Reno, Nevada
Arizona Public Service - Phoenix, Arizona

Objectives

- Develop the process requirements for a hydrogen fuel based power park utilizing photovoltaic and electric grid energy inputs and providing hydrogen energy storage for electricity generation, hydrogen for vehicle fueling, potable water, and chilled water cooling.
- Demonstrate each component required to support the power park concept.
- Analyze the economic viability of the power park based on component costs and performance, and estimates of power park construction cost.
- Develop safe design practices for hydrogen handling.

Technical Barriers

This project addresses the following technical barriers from the Technology Validation section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

- D. Maintenance and Training Facilities
- H. Hydrogen from Renewable Resources
- I. Hydrogen and Electricity Coproduction

Approach

The focus of this project is to evaluate the technical and economic feasibility of a hydrogen fuel based power park. The project will develop the process requirements for a hydrogen fuel based power park designed to provide a maximum electrical power of 100 kW, daily electric energy output of 200 kWh and daily hydrogen motor fuel output of 18 kg. The viability of the process will be demonstrated by development and testing of prototype equipment for each component of the power park process. Based on the results of this testing, performance and cost data will be projected for full size process components. The economic feasibility of the power park will then be evaluated based on alternative resources for electricity generation, hydrogen motor fuel production, production of potable water and chilled water for cooling.

Energy inputs to the power park will include photovoltaic and electric utility grid. A 6-kW photovoltaic array will be used to demonstrate the

photovoltaic component of the power park process. Energy storage will be in the form of gaseous hydrogen produced from either electrolysis of water or a proton exchange membrane (PEM) fuel cell. The hydrogen will be compressed and stored at high pressure (as much as 700 bar). A hydrogen compression and storage system with 172 kg of high pressure hydrogen storage will be used to demonstrate the storage component of the power park concept.

During periods of peak electrical demand, power park electrical output will be supplemented by generation resources fueled with stored hydrogen. A 100-kW hydrogen fueled engine generator will be used to demonstrate the generation component of the power park process. A fuel cell will be incorporated in the power park generation component if found to be economically feasible based on published performance data and prices.

In addition to electrical energy output, the power park will provide hydrogen motor fuel. The Arizona Public Service hydrogen fueled internal combustion engine powered fleet will be used to demonstrate the vehicle fueling component of the power park. The vehicle fleet consists of thirteen vehicles utilizing hydrogen and hydrogen blends with compressed natural gas.

As a byproduct of the electric generation using hydrogen fuel, the power park will provide potable water and cooling. The cooling component of the power park process will be demonstrated using exhaust heat from the 100-kW hydrogen fueled engine generator to produce up to 20 tons of cooling in absorptive cooling units. The potable water component of the power park process will be demonstrated by collecting and processing water from the exhaust of the 100-kW hydrogen fueled engine generator.

With both cost and performance results available from the power park concept component testing, the overall power park performance and economics will be modeled and compared with alternative sources of energy production, storage and delivery. Additionally, power park system safety issues will be evaluated, including design, regulatory, standards and building code issues.